KING COUNTY CONVEYANCE SYSTEM IMPROVEMENT PROJECT

TASK 220

SOUTH SAMMAMISH BASIN FACILITIES REVIEW

OCTOBER 2003

SOUTH SAMMAMISH BASIN FACILITIES REVIEW

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SOUTH SAMMAMISH BASIN
FACILITIES REVIEW

This memorandum reviews the existing wastewater facilities in the South Sammamish Basin that are owned and maintained by the King County Wastewater Treatment Division (KC WTD), as well as those owned and maintained by local agencies. The report includes a description of pumping and piping facilities, as well as current rehabilitation requirements and planned conveyance system changes.

The Sammamish Plateau Water and Sewer District (WSD), and the Cities of Issaquah and Bellevue collect and transport sanitary sewage from their local sewer systems to King County WTD facilities. The County's facilities convey wastewater out of the basin and to the Eastside Interceptor, which carries wastewater to the County's South Plant at Renton. Specific wastewater routing and connections between local and King County sewers are described briefly in this section, and shown in Figures 1 and 2. The following sections describe each of these facilities in greater detail.

- King County facilities extend to the south end of Lake Sammamish. The Issaquah and Issaquah Creek Interceptors convey sanitary wastewater from the Sammamish Plateau WSD and Cities of Bellevue and Issaquah (see Figures 3, 4). The Issaquah Creek Interceptor discharges to the Issaquah Interceptor, which was constructed partially within the lake, along the lake's southwestern shoreline to the King County WTD Sunset Pump Station. Local sewers from Bellevue's Metro 57, Cougar Mountain, Vasa Park and Sammamish Sub-Basins also drain to the Sunset Pump Station (see Figure 6).

- Wastewater is pumped approximately two thirds of a mile along parallel force mains from the Sunset Pump Station to the County's Heathfield Pump Station.

- The Heathfield Pump Station receives the flows from the Sunset Pump Station and pumps them westward to the Eastgate Trunk. Near the force main to gravity transition, additional flows enter the Eastgate Trunk from Bellevue's Leawood, Cougar Mountain, and Eastgate sub-basins (see Figures 5, 7).

- The Eastgate Trunk carries wastewater northward and combines with the Lake Hills Boulevard Siphon to form the Lake Hills Interceptor. Wastewater from Bellevue's Lake Hills, South Larsen Lake, and Phantom Lake sub-basins are added to Eastgate Trunk along the way (see Figure 8). The Lake Hills Interceptor carries flow to the north and then west to the Eastside Interceptor (Section 13), which conveys flows to the South Plant at Renton for treatment.

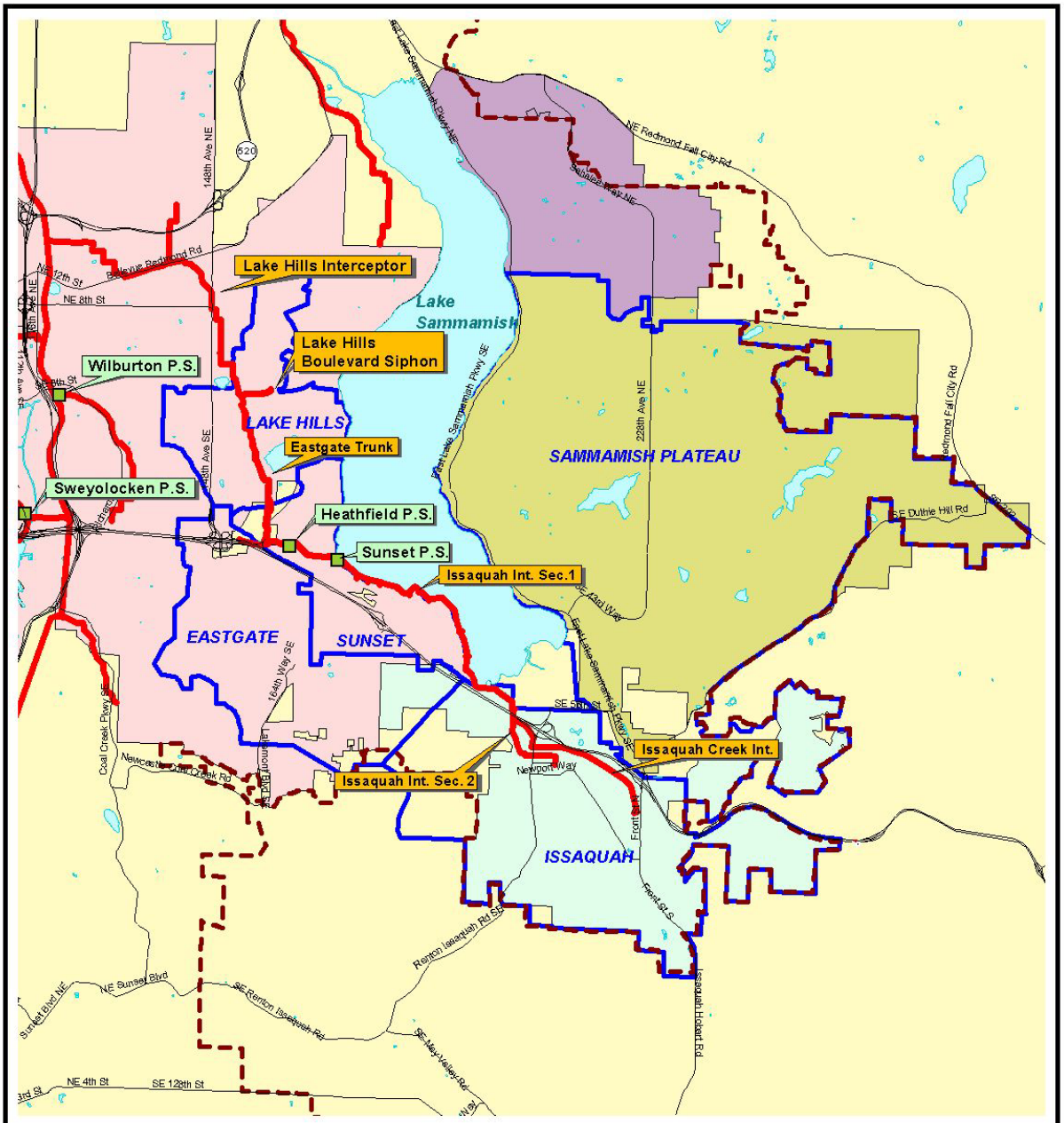

Figure 1: Sammamish Plateau Basin and King County WTD Facilities

Legend
- KC Pump Stations
- KC Sewer
- Urban Growth Act Boundary (1999)
- S Sammamish Planning Basins

Sewer Agencies
- CITY OF BELLEVUE
- CITY OF ISSAQUAH
- NE SAMMAMISH WSD
- SAMMAMISH PLATEAU WSD

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King County Department of Natural Resources

0.6 0 0.6 1.2 1.8 Miles

September 28, 2000

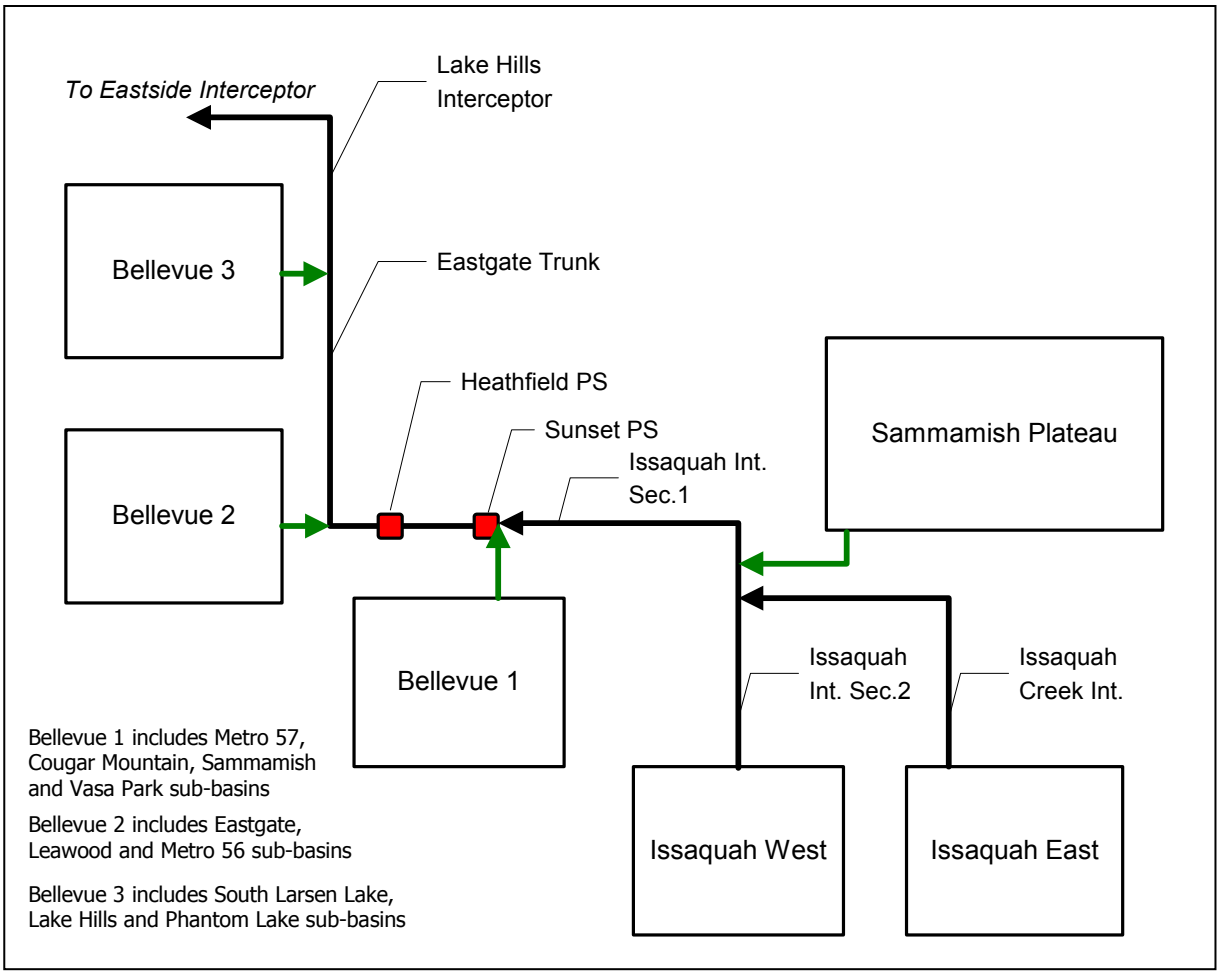

Figure 2. Schematic View of South Sammamish Basin Drainage

LOCAL AGENCY FACILITIES REVIEW

The South Sammamish WSD, and Cities of Issaquah and Bellevue wastewater facilities are summarized in the following sections. The discussion is arranged from upstream to downstream, from the Sammamish Plateau WSD through Issaquah to Bellevue. King County WTD facilities are described following the local agency facilities.

The Sammamish Plateau Water and Sewer District

The Sammamish Plateau WSD service area extends from the western edge of Lake Sammamish eastward beyond the Urban Growth Area (UGA) boundary. Sewer service is provided only within the UGA, while water service is provided throughout the District. According to Sammamish Plateau WSD staff, the area has seen significant residential development and sewer system expansion with the number of connections to the local system nearly tripling in the past 10 years. In addition to single family homes, many of the newer developments include higher density residential and multi-family housing. There is also significant commercial development, particularly along the centrally located 228th Avenue NE corridor.

Continued development will bring higher numbers of customers to the local system for the foreseeable future. Large tracts of undeveloped or sparsely developed land remain available, and the District expects to provide sewer service to all developable land within the UGA boundary in the future (Figure 3). Currently, the District requires new developments to tie into existing sewers, although in some instances, residents are allowed to install septic systems with the understanding that they will connect to the sewer system as the system expands into their area. The District may also annex and provide sewer service to areas outside the current District boundaries but within the UGA boundary, such as the Camden Park development (see Figure 3).

Figure 3 shows the layout of the Sammamish Plateau WSD sewer system. Local sewers drain to the southwest corner of the District service area where there is a connection to the County's Issaquah Interceptor at manhole R17-36, near the south edge of Lake Sammamish State Park. All Sammamish Plateau WSD wastewater discharges to the King County system at this location. Rather than developing in a regular grid pattern, the Sammamish Plateau WSD system has developed in pockets, in response to the construction of new subdivisions. These subdivisions typically generate a small volume of base flow that must travel over the District's predominantly flat topography to connect with the local system. A large number of small lift stations are used as an effective means of transporting wastewater and avoiding solids deposition (see lift stations shown in Figure 3).

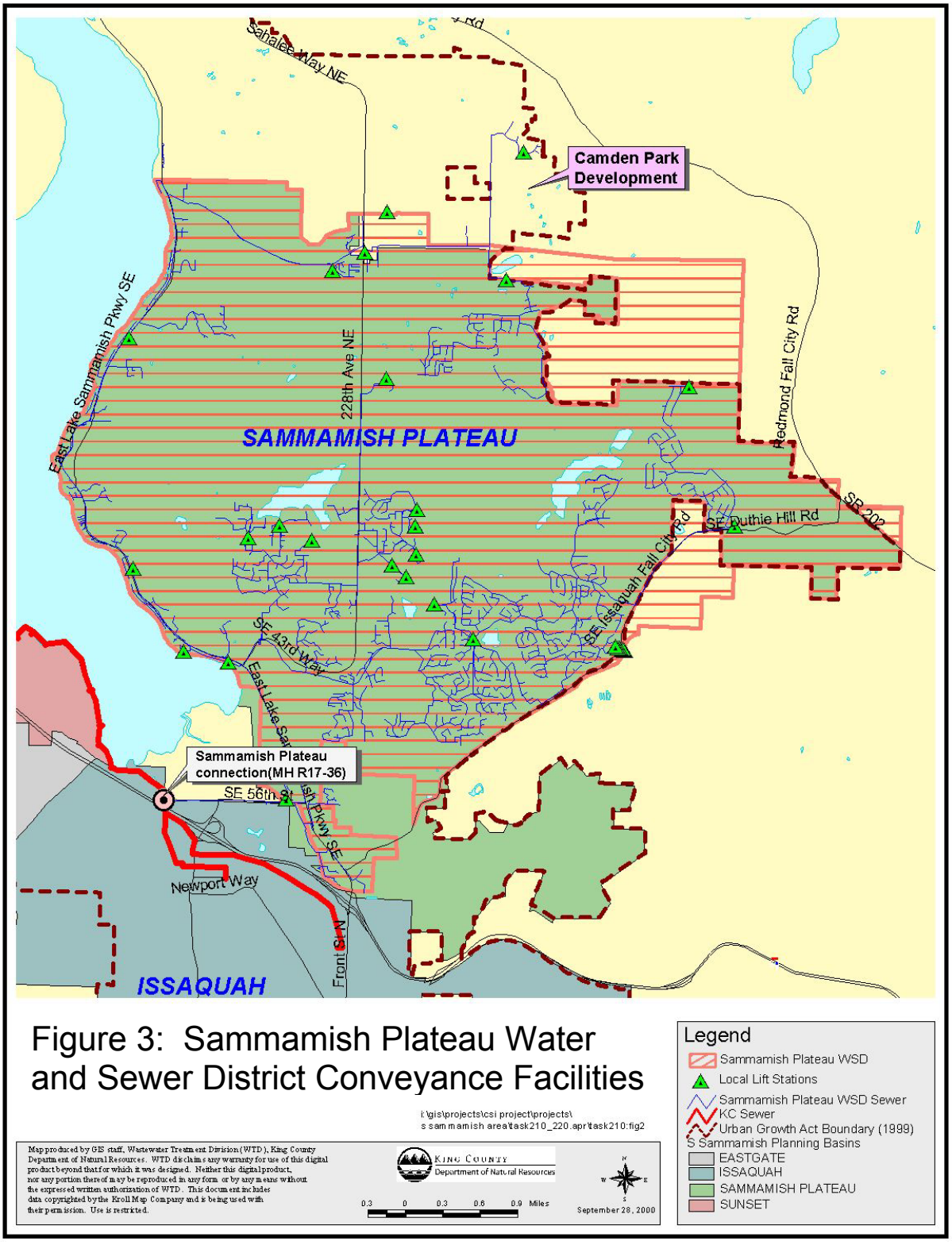

Figure 3: Sammamish Plateau Water and Sewer District Conveyance Facilities

Most of the local sewers range in diameter from 8 inches to 12 inches, although some sewer mains are as large as 36 inches in diameter. According to available data (see Table 1), approximately 10 percent of the District's sewers are larger than 12 inches in diameter. Although sewer construction materials vary, most of newer sewer mains and laterals are constructed of PVC or HDPE. Because of the District's rapid growth, most of pipes are relatively new. The oldest pipes in the District are approximately 25 years old, but most pipes are less than 15 years old.

The District is currently redesigning its connection to the King County system to allow for higher future flows[1]. The final pipe alignment is still undecided, but alternatives include (1) constructing a parallel sewer along the present route, or (2) directionally drilling under Lake Sammamish and Lake Sammamish State Park to connect with the Issaquah Interceptor at the present connection location (manhole R17-36)[2]. Regardless of routing, the hydraulic capacity of the new connection will be considerably larger than at present. According to an analysis contained in the District's *1987 Comprehensive Wastewater Plan Pre-Design Report*, the existing 20-inch diameter pressure sewer has a maximum hydraulic capacity of 8.4 million gallons per day (mgd). The *2000 Draft Engineering Report* for redesigning the connection to King County identified a need for 22.2 mgd of capacity by 2014. Assuming development on the Sammamish Plateau proceeds until the 22.2 mgd capacity of the connection sewer is used, the Sammamish Plateau WSD will account for almost all of the 23.4 mgd capacity of the County's Sunset and Heathfield Pump Stations.

Table 1. Summary of Sammamish Plateau WSD Sewer Facilities

Sewer System Characteristics	
Total length of sewers	~ 110 miles
Total length of sewers larger than 12-inch diameter	~ 10 miles [a]
Number of lift stations	16
Common pipe materials	PVC, HDPE, concrete, ductile iron
Range of pipe ages	Oldest ~25 years; Most less than 15 years

[a] Estimated from available GIS data. Not all sewer pipes have associated diameter in GIS database.

[1] Sammamish Plateau WSD's *1987 Comprehensive Plan* called for local wastewater conveyance to be split, with the northern part of the District redirected around the north end of Lake Sammamish to connect with KC WTD facilities in Redmond. After consultation with KC WTD regarding the redesign of connection to the Issaquah Interceptor, the two agencies decided to size the new facility so that it could accommodate all flows at saturation. Thus the District plans to continue to send all wastewater around the south end of Lake Sammamish. After the connecting sewer is built, KC WTD will acquire the pipeline and assume operation and maintenance responsibilities.

[2] A SEPA review of the route under Lake Sammamish State Park is being conducted.

The City of Issaquah

Located at the south end of Lake Sammamish and along the Interstate 90 corridor, the City of Issaquah operates a wastewater collection system that discharges to KC WTD's Issaquah and Issaquah Creek Interceptors (Figure 4). While the Issaquah basin includes approximately 30 square miles, only a portion of the basin is served by the City of Issaquah municipal system. Much of the basin is either undevelopable due to environmental constraints (e.g. steep slopes, wetlands; see Task 230) or has been sparsely developed and served by on-site systems.

The local collection system consists of gravity sewers that drain to the northwest into either the Issaquah Interceptor or the Issaquah Creek Interceptor. One lift station and a 6-inch diameter force main connect two small sub-basins (Holiday Inn and Pickering Place Retail Center) located north of I-90 to the Issaquah Interceptor. The local sewers range up to 18 inches in diameter, with most sewers measuring 8 inches in diameter. The City's sewer service area flows are divided roughly evenly between the two King County WTD interceptors. Generally, areas east of NW Newport Way flow to the Issaquah Creek Interceptor, while the remaining service area flows to the Issaquah Interceptor. The City's local gravity sewers connect to the King County WTD interceptors in a number of different locations. Table 2 summarizes Issaquah's conveyance facilities.

Table 2. Summary of City of Issaquah Sewer Facilities

Sewer System Characteristics	
Total length of sewers	55 miles
Total length of sewers larger than 12-inch diameter	2.5 miles
Number of lift stations	1
Range of pipe ages	Oldest ~60 years; Many less than 15 years

The number of residents connected to the City's local sewer system, and the corresponding loading to the King County WTD system, is expected to increase considerably in the next decade. Major new developments will be served by sanitary sewer. As the sewer system extends into areas currently served by septic systems, the septic systems will be converted to sewer service. The timing of the system growth is important, as it affects the scheduling for King County WTD improvements to its conveyance system. June 1999 population forecasts by the Puget Sound Regional Council (PSRC) predict steady growth for Issaquah over the next 50 years. The City of Issaquah Public Works Department, on the other hand, foresees rapid growth in the next decade, followed by decades of slower growth[3].

[3] Issues of land use and population forecasting are discussed in greater detail in the Task 210 and 230 reports. It is mentioned here simply to demonstrate that the Issaquah sewer system is likely to expand during the next decade as already planned local developments are constructed.

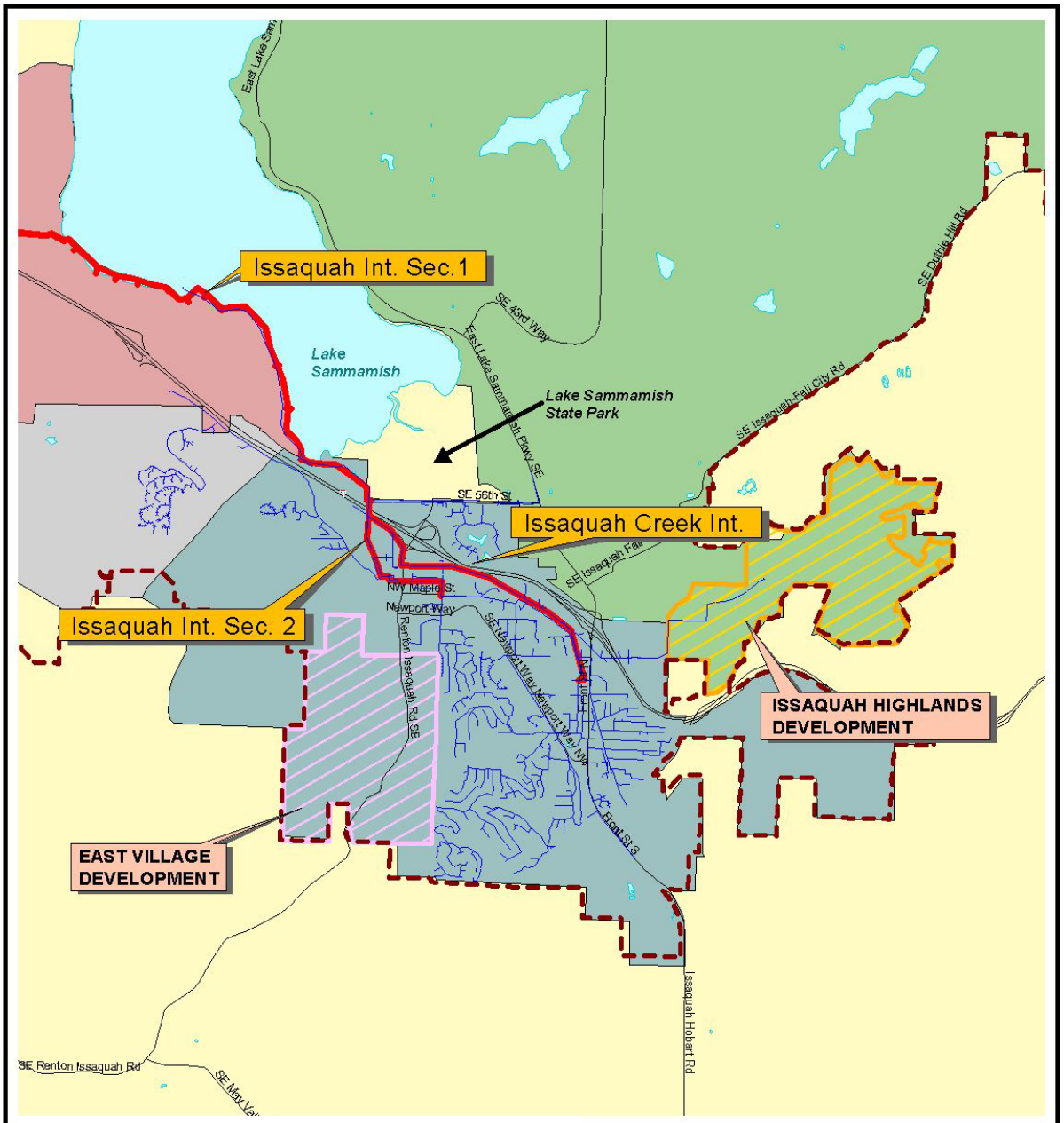

Figure 4: City of Issaquah Sewer System

Presently, there are two major residential developments planned for Issaquah: the East Village development and the Issaquah Highlands development (Figure 4). The Issaquah Highlands development is an annexation area previously within the Sammamish Plateau WSD service area. These two developments, together with small pockets of development elsewhere in the Issaquah service area, will likely cause the sewer service area population to double by 2010. At that time, according to Issaquah Public Works Department staff, the service area will be close to the maximum development permitted under present zoning and long range plans.

The City of Issaquah has some of the oldest sewers in the South Sammamish Basin. There are sewers dating back to 1939 operating in the downtown city area. City and King County staff have indicated that there are some capacity issues during wet weather events for these downtown sewers. According to Issaquah staff, these capacity problems would be alleviated by expanding the City's West Downtown Trunk from 10 – 15 inches in diameter to 12 – 18 inches in diameter. In an effort to reduce the amount of infiltration and inflow (I/I) entering the sewer system, Issaquah is conducting an ongoing program to line all pre-1958 sewer mainlines with an in-situ, impregnated resin. The rehabilitation is limited to sewer mains and does not include public, lower side sewers. The program is scheduled to be completed during 2001.

The two large, new developments will increase total flows, but the flows will be routed so as to limit impacts on existing local sewers, particularly the capacity limited downtown sewers. The East Village development will be served by a new, local trunk sewer that will discharge directly to the Issaquah Interceptor (Section 1) near the intersection of 12th Avenue NW and NW Mall Street or State Route 900 and NW Mall Street. Routing is still undecided, but the connection will probably occur between manholes R17-51 and R17-45. Land is being cleared for the start of construction, and phased development plans will result in a gradual increase in the wastewater added to the Issaquah Interceptor (see Task 230 for development details). The Issaquah Highlands development is an annexation area previously within the Sammamish Plateau WSD service area. A local sewer is in place to convey wastewater from the Issaquah Highlands to an upper section of the Issaquah Creek Interceptor (manhole R17-51A). Ten percent of the Issaquah Highlands already constructed, and the rate of development and wastewater loading to the Issaquah Creek Interceptor will increase rapidly once the I-90 Sunset Exchange is opened in 2003.

The City of Bellevue

The City of Bellevue operates one of the largest sewage collection systems in King County, covering more than 40 square miles, of which more than 8 square miles (5,400 acres) lie within the South Sammamish Basin study area (Figure 5). Within the study area, there are various Bellevue sub-basins that have different sewered area densities, ages of construction, and discharge points to the King County conveyance system. The Bellevue sub-basins and facilities are described and arranged by their connection points to the King County WTD system (e.g. from upstream of the Sunset Pump Station to downstream of the Eastgate Trunk).

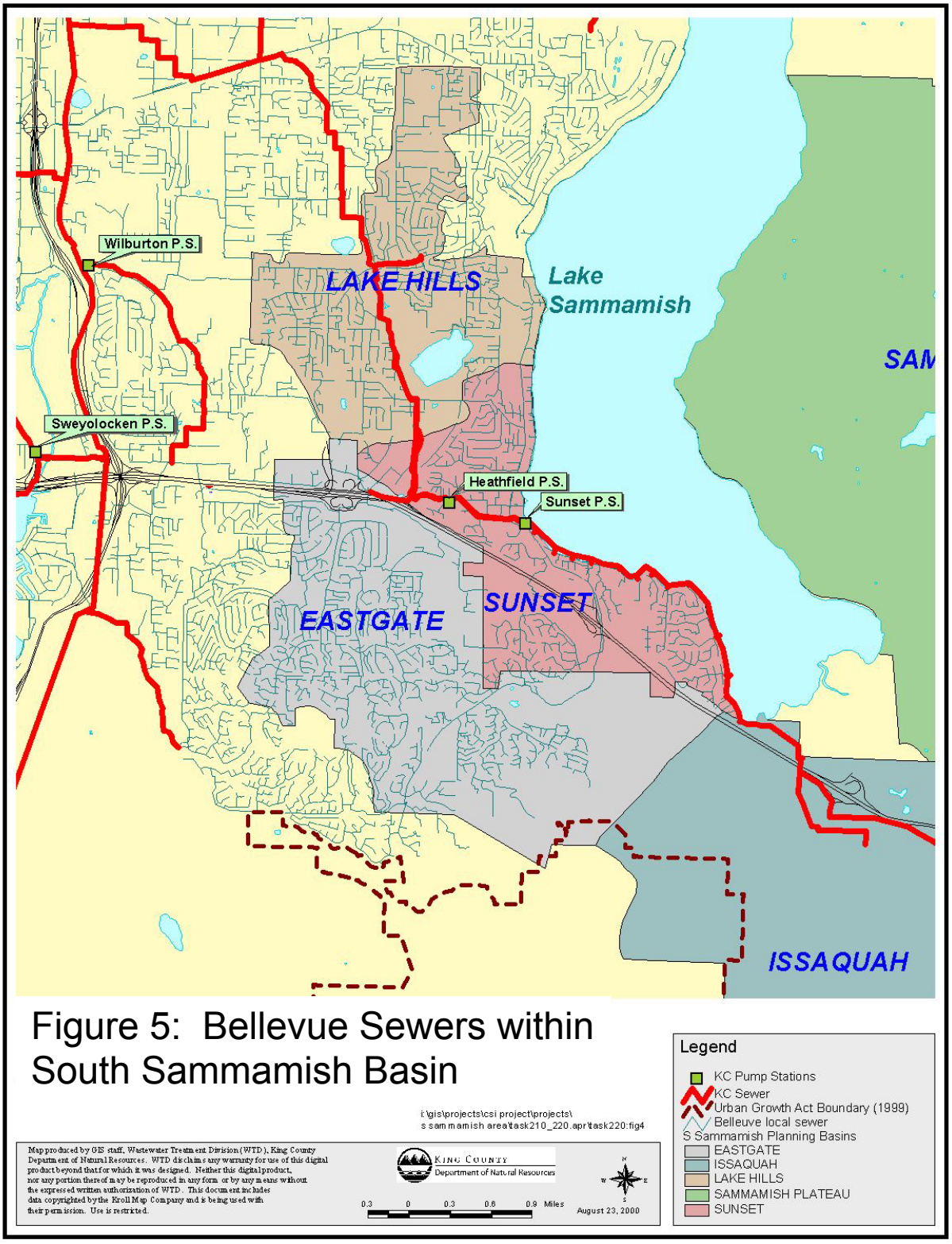

Figure 5: Bellevue Sewers within South Sammamish Basin

Bellevue Sub-Basins and Facilities Upstream of the Sunset Pump Station

Four Bellevue sub-basins drain to the Issaquah Interceptor: Metro 57, Cougar Mountain, Sammamish and Vasa Park. Flow from these three sub-basins together with Sammamish Plateau WSD and Issaquah flows form the total influent to the Sunset Pump Station.

Bellevue Metro Sub-Basin 57 Facilities

Metro Sub-Basin 57, located along the southwest shore of Lake Sammamish at the southern end of the Bellevue service area (Figure 6), drains into King County's Issaquah interceptor in 13 separate locations. Sub-Basin 57 is a small sub-basin with no pump stations or large-diameter sewers. Sewage from the sub-basin is collected by lateral sewers and transported by sewer mains to 13 separate manholes along the Issaquah Interceptor. In this location, the Issaquah Interceptor is aligned within the south end of Lake Sammamish – the local sewers connect to the interceptor underwater.

Prior to the January 1, 1995, the date on which the City of Bellevue annexed the Eastgate Sewer District, the Eastgate District operated the sewers in Metro Sub-Basin 57, which was then known as Eastgate's Sammamish Basin. When Eastgate updated its sewer plan in 1994, the sewer district chose not to model the basin because it contained no interceptors or trunk lines. Therefore, data on sub-basin flows are limited. The sub-basin includes about 460 acres, nearly all of which is presently developed to the maximum extent permitted by current Bellevue land use plans and zoning ordinances. Capital improvements recommended by the *1994 Eastgate Sewer District Comprehensive Sewer Plan* included two segments of 8-inch diameter sewer on either side of Timberlake Park to allow about 31 lots to convert from on-site treatment to connect to the sewer. Completion of those segments and inclusion of the flows from the affected property was assumed in the *1994 Eastgate Comprehensive Sewer Plan*.

Bellevue Cougar Mountain Sub-Basin

The 1,430 acre Cougar Mountain Sub-Basin is the largest of Bellevue's sub-basins within the South Sammamish Basin planning area (Figure 6). At the time of the *1994 Bellevue Comprehensive Sewer Plan*, Cougar Mountain had about 6,196 residents and was considered 55 percent developed. The sub-basin is expected to reach its saturation density by 2005 to 2010, when it will include 11,265 residents. Essentially all land use within the sub-basin is expected to be residential. There are approximately 135,000 lineal feet of gravity sewers from 6 to 12 inches in diameter and no pumping stations. The hydraulic modeling study conducted in connection with the *1994 Bellevue Comprehensive Sewer Plan*, using modest assumptions about wet weather flow[4], indicated that existing sewers have sufficient capacity to convey flows from the sub-basin as it reaches build out condition. With build out expected to occur in the next 10 years, flows to the Sunset and Heathfield Pump Stations from this sub-basin will increase.

[4] The hydraulic model assumed 85 gpcd base wastewater for residential use and 20 gpcd for commercial use. To develop wet weather flows, a basin area-dependent, peaking factor was applied to the base wastewater: PF = 4 for 100 acre basins, PF = 3 for 1,000 acre basins and PF = 2.2 for 5,000 acre basins, in addition to 1,100 gpad infiltration and inflow.

Bellevue Vasa Park and Sammamish Sub-Basin Facilities

Two Bellevue sub-basins discharge to the County's Sunset Pump Station (Figure 6). One sub-basin, Vasa Park, was part of the original Bellevue sewer system. The other sub-basin, now called Sammamish, was originally part of the Eastgate Sewer District. This basin was also called "Vasa Park" by Eastgate before Bellevue annexed the Eastgate Sewer District on January 1, 1995. Bellevue's Sammamish Sub-Basin lies between West Lake Sammamish Parkway and the Lake Sammamish, north of the County's Sunset Pump Station, and east of the Vasa Park Sub-Basin.

The Vasa Park Sub-Basin contains approximately 411 acres. Part of the sub-basin is in the City of Bellevue and part is in unincorporated King County. The basin is zoned 93 percent residential and 7 percent light industrial and is essentially fully developed. There are approximately 55,000 lineal feet of gravity sewers that range in size from 6 to 12 inches in diameter. The basin includes one local pump station (Lake Hills Pump Station No. 7, located at 16280 SE 24th Street, Bellevue). The station has two pumps and no on-site backup power capability. Most of the sewers were constructed in the 1960s.

A hydraulic analysis study performed for the *1994 Bellevue Comprehensive Sewer Plan Update* (using same flow assumptions as Cougar Mountain study, described above) identified ten pipes in the Vasa Park Sub-Basin as more than 110 percent over capacity during peak flow periods. Subsequent flow monitoring by the city confirmed that one of these pipes was surcharged during storm conditions. However, there was no evidence of adverse storm impacts, such as overflows or backups into side sewers resulting from a surcharged condition. A consultant evaluated the surcharged segment of pipe, and confirmed that the increased head resulting from surcharge conditions would force flow through the existing pipes without creating overflows or backups.

The Sammamish Sub-Basin consists of a narrow finger of land along Lake Sammamish. Only 264 acres are included in the sub-basin because a regional park within the sub-basin is not considered developable. With the exception of the regional park, the area is considered fully developed. Among its wastewater conveyance facilities, the sub-basin includes a single 300 gpm lift station, Lift Station No. 1. Lift Station No. 1 discharges to the 3,897 foot-long, ten-segment, 10-inch diameter, Lake Line Interceptor. Modeling in 1994 showed that seven of the 10 segments to this lake line were over capacity, owing primarily to the lack of grade in the pipe. However, since the Lake Lie Interceptor is essentially a pressurized pipeline (the manholes are tight-line manholes), surcharging is expected and does not result in overflows. No capital improvements to the line were recommended in the *Eastgate Comprehensive Sewer Plan*. The Lake Line Interceptor joins the 12-inch diameter Landward Interceptor, and a 14-inch gravity sewer conveys the joined flows to the County's Sunset Pump Station.

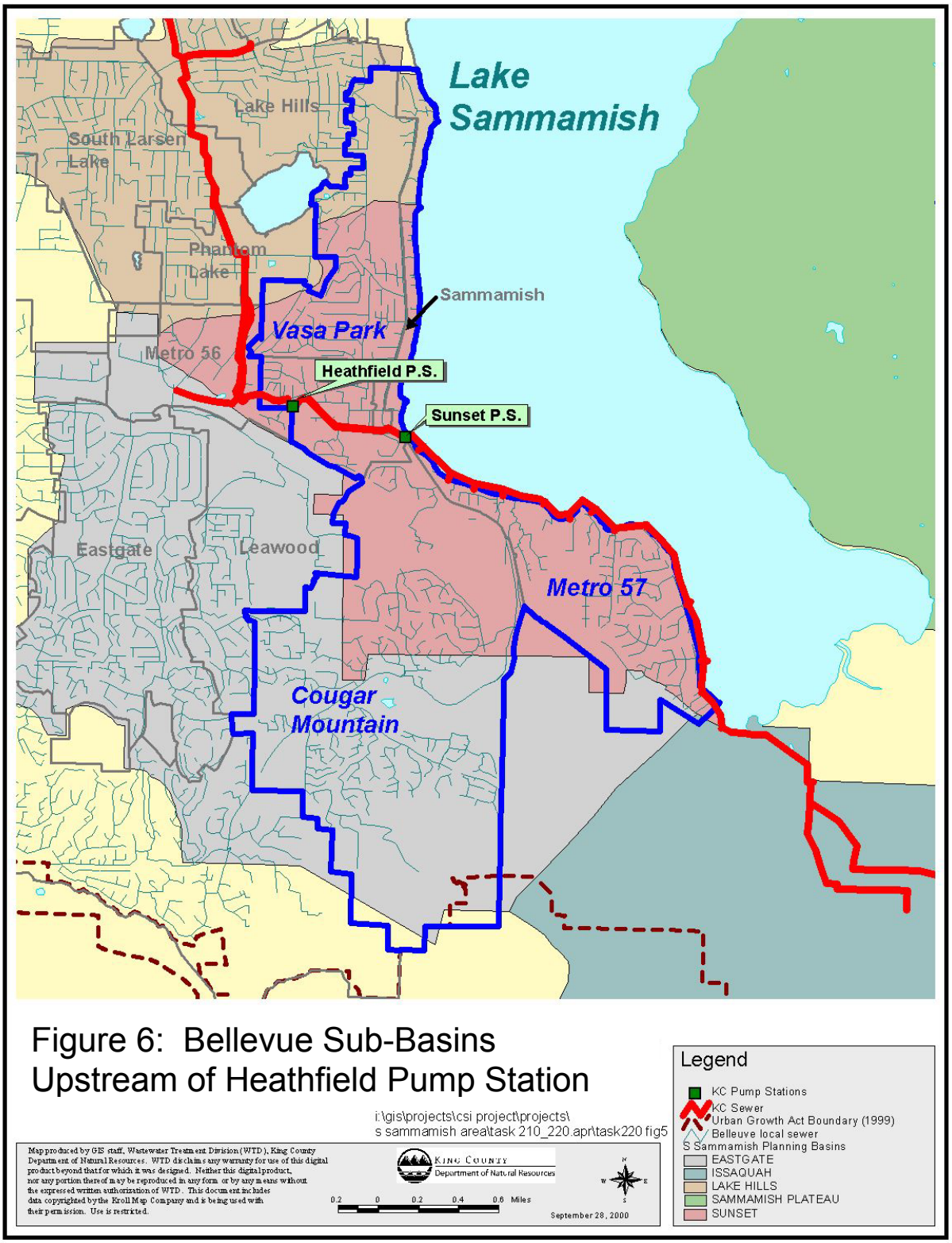

Figure 6: Bellevue Sub-Basins
Upstream of Heathfield Pump Station

Table 3 summarizes the conveyance system in the Vasa Park, Sammamish and Cougar Mountain Sub-Basins.

Table 3. Bellevue Sub-Basins and Facilities Upstream of the Sunset Pump Stationa

Sub-Basin	Area (acres)	Sewer Length (lineal feet)	Number of Lift Stations	Range of Pipe Diameters
Metro 57	464	54,923	0	6 to 12 in
Cougar Mountain	1,430	135,226	0	6 to 12 in
Vasa Park	411	54,775	1	6 to 12 in
Sammamish	264	29,964	1	10 to 14 in

a. Computed from GIS data provided by the City of Bellevue Department of Public Works

Bellevue Sub-Basins and Facilities Draining to the Eastgate Trunk Upstream of the Convergence with the Heathfield Pump Station Discharge

Three Bellevue sub-basins drain to the upstream end of the Eastgate Trunk, prior to the convergence with the Heathfield Pump Station discharge: Eastgate, Leawood and Sub-Basin Metro 56 (Figure 7). Leawood contains a number of unsewered lots (i.e. undeveloped or served by on-site sewage treatment systems), while Bellevue's Eastgate Sub-Basin is essentially 100 percent developed and has reached its saturation density. Metro 56 is a small sub-basin that is not densely developed.

The Eastgate and Leawood Sub-Basins include the mostly developed, commercial land around the Eastgate interchange of I-90, and the less-developed residential area served by the Leawood Interceptor. Together, the combined sub-basins had a 1994 equivalent population of 18,654 residential equivalents, and by the time the sub-basins reach buildout (expected in 2005), the basin will include 21,946 residential equivalents.

Table 4 summarizes the conveyance system facilities in Bellevue's Eastgate, and Leawood Sub-Basins.

Table 4. Bellevue Sub-Basins and Facilities Draining to the Eastgate Trunk Upstream of the Convergence with the Heathfield Pump Station Discharge[a]

Sub-Basin	Area (acres)	Sewer Length (lineal feet)	Number of Lift Stations	Range of Pipe Diameters
Eastgate	801	131,315	0	8 to 24 in
Leawood	480	48,167	0	8 to 18 in
Metro 56	249	11,834	0	8 to 15 in

a. Computed from GIS data provided by the City of Bellevue Department of Public Works

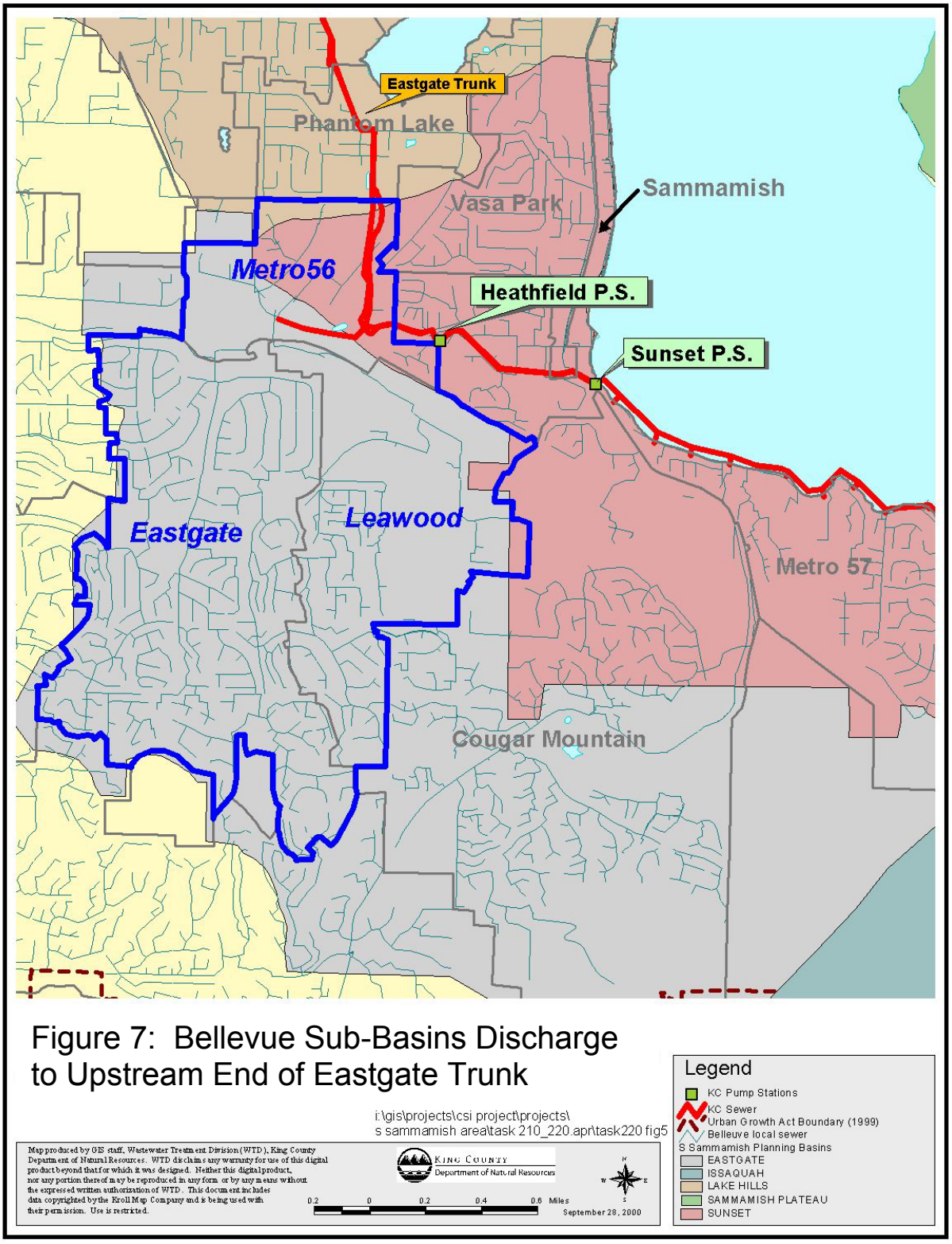

Figure 7: Bellevue Sub-Basins Discharge to Upstream End of Eastgate Trunk

Bellevue Sub-Basins and Facilities Upstream of the Lake Hills Interceptor

Bellevue's South Larsen Lake and Phantom Lake Sub-Basins drain into the Eastgate Trunk upstream of the Lake Hills Interceptor (Figure 8). The Lake Hills Sub-Basin drains mostly to KC WTD's Lake Hills Boulevard Siphon, with a small portion draining to the siphon outlet. The Eastgate Trunk and Lake Hills Boulevard Siphon combine to form the Lake Hills Interceptor which flows out of the South Sammamish Basin (see following section for more detail on King County facilities). These three Bellevue sub-basins combine to form the majority of King County's Lake Hills Basin.

South Larsen Lake Sub-Basin contains 587 acres, all but 21 acres of which is zoned residential. The sub-basin contains about 70,000 lineal feet of gravity sewers, ranging in size from 6 to 18 inches in diameter. The area is considered fully developed, and the sewer system dates back to the 1950's.

The 496 acre Lake Hills Sub-Basin, similar to South Larsen Lake, is almost entirely residential and fully developed with sewers constructed during the 1950's. The sub-basin is served by nearly 63,000 lineal feet of 6-inch to 12-inch diameter gravity sewer and force main. Two small lift stations, Bellevue Lake Hills No. 4 and No. 5, serve the sub-basin. Each station has two pumps and no backup power generation.

The Phantom Lake Sub-Basin was called "Eastgate" in the *1994 Bellevue Comprehensive Plan Update*. When Bellevue annexed the Eastgate Sewer District in 1995, the name Eastgate was changed to "Phantom Lake" since Eastgate Sewer District already included an Eastgate Sub-Basin. The fully developed sub-basin contains 210 acres, 82 percent of which was zoned residential in 1994 and the remaining 18 percent was zoned commercial. The collection system contains about 21,000 lineal feet of 6 to 12-inch gravity sewer and no pumping facilities. Sewers were constructed in the 1960s.

Table 5 summarizes the conveyance system facilities in Bellevue's South Larsen Lake, Lake Hills, and Phantom Lake Sub-Basins.

Table 5. Bellevue Sub-Basins and Facilities Upstream of the Lake Hills Interceptor[a]

Sub-Basin	Area (acres)	Sewer Length (lineal feet)	Number of Lift Stations	Range of Pipe Diameters
South Larsen Lake	587	70,495	0	6 to 18 in
Lake Hills	496	62,887	2	6 to 12 in
Phantom Lake	236	20,917	0	6 to 12 in

a. Computed from GIS data provided by the City of Bellevue Department of Public Works.

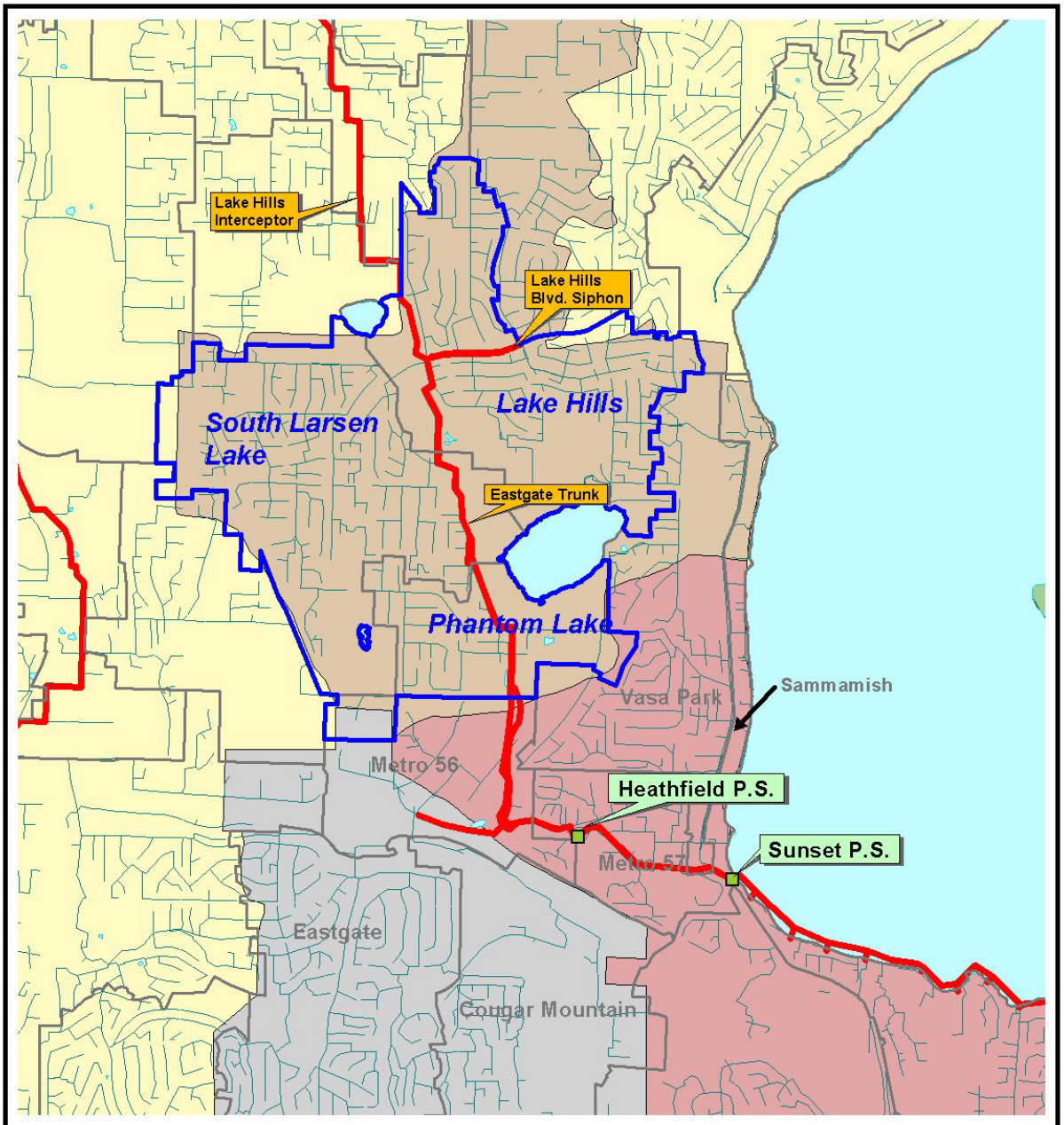

Figure 8: Bellevue Sub-Basins Discharging to Eastgate Trunk

KING COUNTY WASTEWATER TREATMENT DIVISION FACILITIES REVIEW

King County owns and maintains a system of interceptor sewers, an inverted siphon, and pump stations in the South Sammamish Basin. The key characteristics of the sewers and pump stations, shown in Figure 1, are described in the following sections. The facilities are discussed in order from upstream to downstream locations.

Issaquah Creek Interceptor

The Issaquah Creek Interceptor drains the eastern half of the City of Issaquah. It was constructed in 1982 to relieve sections of the Issaquah Interceptor that were flowing near capacity through the City during wet weather. The Issaquah Creek Interceptor is 21 inches in diameter and extends for approximately two miles along NW Gilman Boulevard before discharging to the Issaquah Interceptor at manhole R17-37, which is located near I-90. Figure 9 shows the manhole-to-manhole full pipe capacity in the Issaquah Creek Interceptor[5].

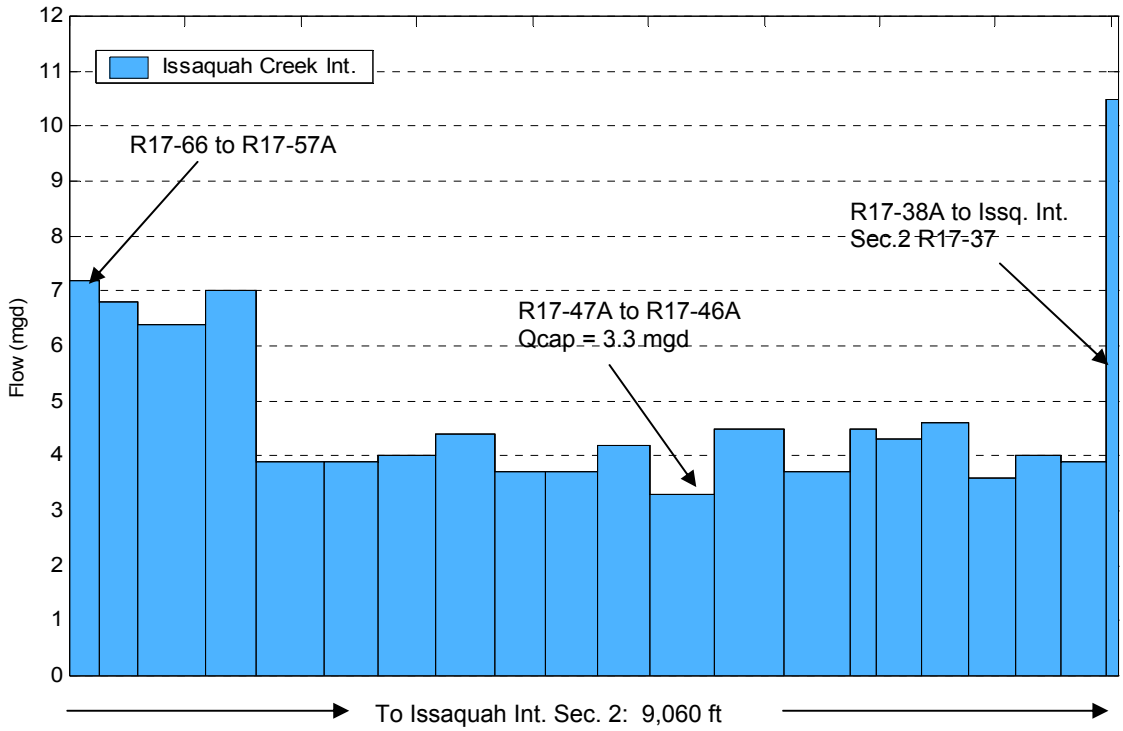

Figure 9. Issaquah Creek Interceptor full pipe capacity.

[5] The full pipe capacity of the Issaquah Creek Interceptor was computed for each pipe section using the Manning's equation with the friction parameter, n = 0.013. The capacity of other trunks/interceptors was computed similarly, except where noted.

Issaquah Interceptor

The Issaquah Interceptor is the primary conveyance facility draining the southern and western parts of the South Sammamish Basin. It drains the western part of the City of Issaquah by numerous local connections and receives flow from the rest of the Issaquah system via discharge from the Issaquah Creek Interceptor. The connection with the Issaquah Creek Interceptor, at manhole R17-37, occurs approximately one mile from the upstream end of the Issaquah Interceptor. All Sammamish Plateau WSD system flows enter the Issaquah Interceptor at manhole R17-36, near Lake Sammamish State Park (see Sammamish Plateau WSD section for information on this connection). Downstream of manhole R17-36, the Issaquah Interceptor runs approximately one-half mile to Lake Sammamish and three miles of gravity flow in Lake Sammamish to the Sunset Pump Station. Flow is added through small connections from Bellevue's Metro 57 Sub-Basin.

The Issaquah Interceptor was constructed in 1962 of reinforced concrete pipe. Upstream of the confluence with the Issaquah Creek Interceptor, the pipe diameter ranges from 21 to 24 inches. Downstream of the confluence and in Lake Sammamish, the pipe is 48 inches in diameter. The lake line portion of the interceptor has two flushing stations that allow the introduction of freshwater from Lake Sammamish during periods of low flow to reduce odor. A 21-inch diameter flushing structure is located near the far upstream end of the lake at manhole R17-30, while a smaller 10-inch diameter flushing structure is located near the downstream end of the lake line at manhole R17-2. The interceptor also has two emergency overflow lines to protect downstream equipment, including the Sunset Pump Station (see next section for details).

The condition of the Issaquah Interceptor is very important, because the pipe conveys all wastewater from Issaquah and Sammamish Plateau. According to King County facilities inspection staff, the recent assessment showed the pipe material is in good condition, but the pilings and shoring within Lake Sammamish are deteriorating.

The Issaquah Interceptor is divided into two sections: Section 1 and Section 2. Section 1 is the more downstream, lake line portion of the pipeline, running from manhole R17-31 to the Sunset Pump Station. Section 2 runs through the City of Issaquah, picking up flow from the Issaquah Creek Interceptor and the Sammamish Plateau. The full pipe capacities of the two sections of the Issaquah Interceptor are shown in Figures 10 and 11.

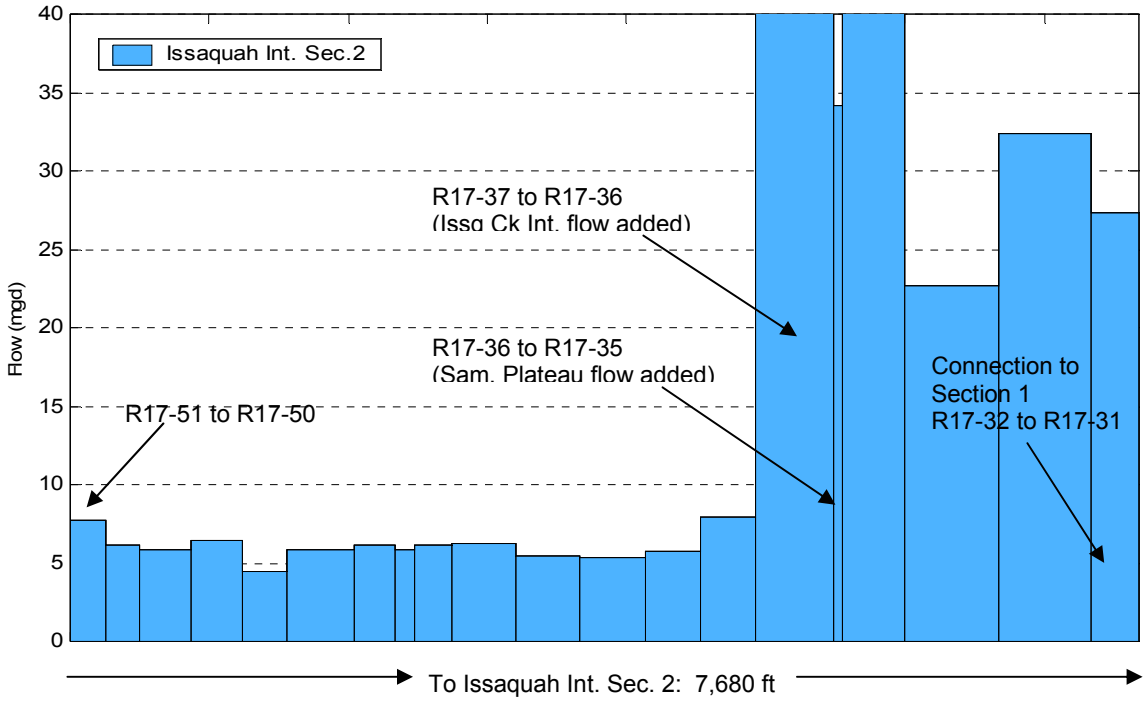

Figure 10. Issaquah Interceptor Section 2 full pipe capacity.

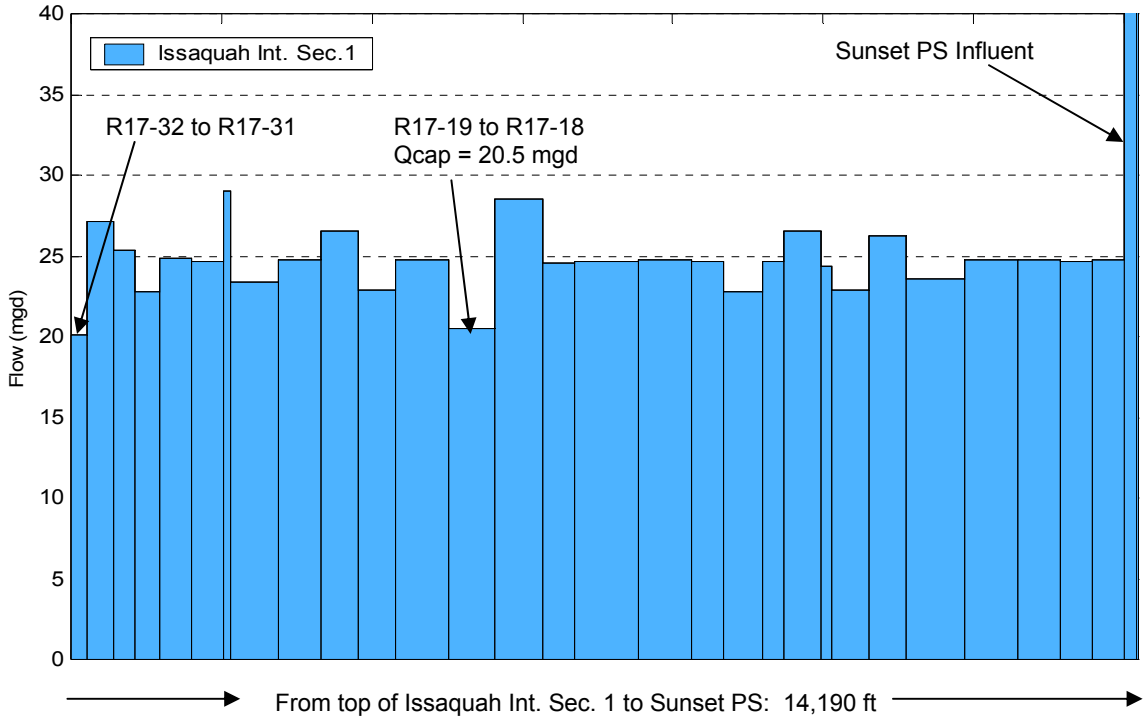

Figure 11. Issaquah Interceptor Section 1 full pipe capacity

Sunset Pump Station and Force Main

At the downstream (northwest) end of the Issaquah Interceptor is the Sunset Pump Station. The pump station is located at 3730 West Lake Sammamish Parkway in Bellevue. Originally constructed as an interim pump station in the 1960's pending completion of a planned 42 mgd Vasa Park pump station, the station was rebuilt as the Sunset Pump Station in 1987 when it was decided not to build the Vasa Park Pump Station.

The Sunset Pump Station receives influent flows from the Issaquah interceptor and from a 10-inch diameter and a 14-inch diameter connection from the City of Bellevue's Vasa Park and Sammamish Sub-Basins. Four variable-speed driven pumps (two 3.8 mgd capacity centrifugal screw pumps and two 10.8 mgd vertical non-clog centrifugal pumps) provide up to 23.4 mgd of pumping capacity. Two 3,220-foot long ductile iron force mains (12-inches and 24-inches in diameter) carry wastewater from the Sunset Pump Station to the Heathfield Pump Station.

The overflow structures associated with the Sunset Pump Station are not located at the pump station, but upstream in the Issaquah Interceptor. Manholes R17-20 and R17-23, which are approximately 1.8 and 2.1 miles from the pump station, respectively, each have 30-inch diameter overflow lines that discharge to Lake Sammamish when the wastewater elevation in the interceptor reaches 28 feet above mean sea level (standard KC WTD datum). The capacity of the Sunset Pump Station is sufficient to meet present wet weather flow demand. There have been no identified discharges in the past several years from the two overflow structures.

The pump station is powered by dual source utility power, and an uninterruptible power supply provides backup power to the control equipment. Odor control is by means of an activated carbon scrubber filter. The equipment installed at the Sunset Pump Station is summarized in Table 6.

Table 6. Sunset Pump Station Equipment Information

Component	Characteristics
Influent Gate	Hydraulically-operated 42-inch by 42-inch Olympic Foundary
Pumps 1 and 2 Pumps: Motors: Variable Frequency Controller:	 Wemco-Hidrostal, screw centrifugal pump, capacity is 3.8 mgd against 166 ft. TDH; Westinghouse frame 449 HP 16, rated @ 200 hp, 1,200 rpm; 460 volt, three-phase, 60 Hz Westinghouse adjustable frequency AC controller, Accutrol 300, rated at 200 hp
Pumps 3 and 4 Pumps: Motors: Variable Frequency Controller:	 Worthington vertical non-clog centrifugal pump, capacity is 10.8 mgd against 172 ft. TDH; Westinghouse AC motor, rated @ 450 hp Westinghouse adjustable frequency AC controller, Accutrol 300, rated at 500 hp
Utility Power UPS	Puget Power (dual source power) Custom Power, Inc.
Odor Control System	Westates Carbon Co. type UOC-H activated carbon

Heathfield Pump Station and Force Main

The Heathfield Pump Station is located just north of Interstate 90 at 3541 163rd Avenue SE in Bellevue. The pump station receives all flow from the two Sunset force mains, as well as flows from a 10-inch diameter local sewer that drains a few blocks of Bellevue's Metro 56 basin.

The Heathfield Pump Station is in most respects a similar to the Sunset Pump Station. Both were built in the 1960's and rebuilt in 1980's. Both stations were equipped with identical variable frequency-driven pumps, and both stations have identical pumping capacities (23.4 mgd). Like Sunset, the Heathfield Pump Station discharges via two force mains (one a 12-inch diameter pipe, the other 24 inches in diameter). The Heathfield force mains are 1,650 feet long and discharge to the Eastgate Trunk. According to the *Offsite Facilities and Miscellaneous Structures Manual, Vol. 1, East Section* (Revision B, 1994), the maximum operating pumping rate was initially held to about 15 mgd to prevent overflows downstream in the Eastgate Trunk. Completion of the last parallel section of the Eastgate Trunk (from manhole R11-60B to R11-57B) in 1993 eliminated the bottleneck, and now the pump stations are able to operate at their full rated capacity.

The equipment used at Heathfield is listed in Table 7. The Heathfield and Sunset pump stations differ in one respect. Heathfield does not have an uninterruptible power supply like Sunset to provide power to the control equipment in the event of a utility outage. High flows occurring at times of power outage have resulted in occasional overflows at Heathfield.

Overflows from the pump station are directed through a local sewer to the Sunset Pump Station or to a storm drain and detention basin. In local manhole, MH6, there is a storm drain influent pipe 6 feet above the invert of the manhole. When overflow rates are high

enough at MH6, wastewater is routed to the storm drain and detention basin. The detention basin outlet leads to a storm sewer that discharges to Lake Sammamish. In the absence of a power failure, the capacity of the Heathfield Pump Station is sufficient for present peak wet weather flows.

Table 7. Heathfield Pump Station Equipment Information

Component	Characteristics
Pumps 1 and 2	
Pumps:	Wemco-Hidrostal, screw centrifugal pump, capacity is 3.7 mgd against 169 ft. TDH;
Motors:	Westinghouse vertical solid shaft, rated @ 200 hp, 1,170 rpm; 460 volt, three-phase, 60 Hz; frame no. 449 HP 16
Variable Frequency Controller:	Westinghouse adjustable frequency AC controller, Accutrol 300, rated at 200 hp
Pumps 3 and 4	
Pumps:	Worthington vertical non-clog centrifugal pump, capacity is 11 mgd against 169 ft. TDH;
Motors:	Westinghouse AC motor, rated @ 450 hp, 1,187 rpm; frame 5010 3UP24
Variable Frequency Controller:	Westinghouse adjustable frequency AC controller, Accutrol 300, rated at 500 hp
Utility Power	Puget Power (dual source power) (no backup or UPS)
Odor Control System	Westates Carbon Co. type UOC-H activated carbon; capacity 2,000 lbs.
Monorail Hoists	Four ACCO, trolley-suspended, series 15; 3 ton capacity; 16 ft. vertical lift

Eastgate Trunk

Wastewater through the much of the Bellevue section of the South Sammamish Basin is conveyed by the Eastgate Trunk. The first one-third mile of the trunk consists of 24-inch diameter pipe, constructed in 1964, that picks up relatively small flows from local Bellevue sewers. After the first one-third mile section, the capacity and flows in the Eastgate Trunk increase substantially. The Heathfield Pump Station force mains discharge to manholes R11-67 and R11-67A, and the Eastgate Trunk conveys northward all wastewater from Issaquah and the Sammamish Plateau WSD, as well from the Eastgate and Sunset Basins in parallel gravity sewers.

When the original sections of the Eastgate Trunk were built in 1964, the northward sections of the trunk ranged in diameter from 22 to 36 inches, with most sections using 24-inch diameter pipe. The Eastgate Trunk was paralleled in the 1980's to coincide with the expanded capacities of the rebuilt Sunset and Heathfield Pump Stations. The parallel sewer ranges in size from 24 to 48-inch diameter, with the majority of pipe sections measuring 36 inches in diameter. The parallel pipes extend between 1.5 and 2 miles before discharging to the Lake Hills Interceptor at manhole R03-49. The route of the parallel sewer is congested. In addition to the King County sewer, a local Bellevue trunk parallels the Eastgate Trunk. Alternatives that include increasing hydraulic capacity must consider the utility congestion along the Eastgate Trunk route. Figure 12 shows the capacity of the Eastgate Trunk.

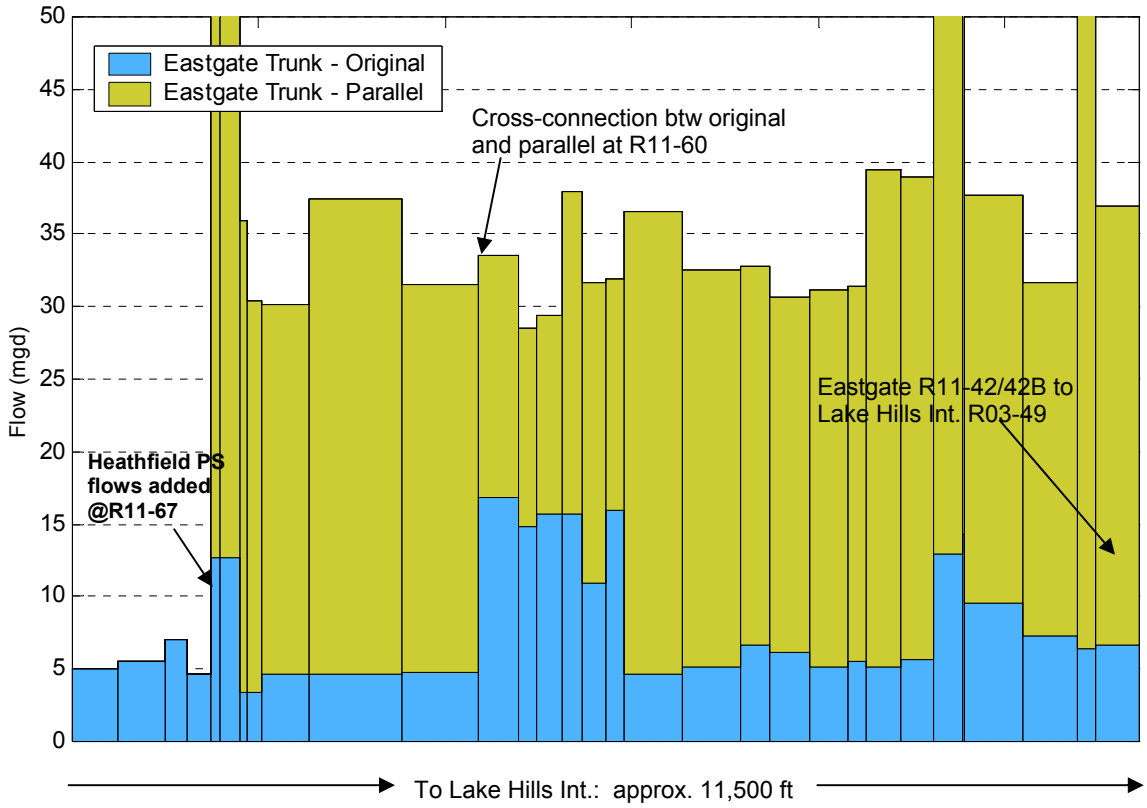

Figure 12. Eastgate Trunk original and parallel line full pipe capacity

Lake Hills Boulevard Siphon

The Lake Hills Boulevard Siphon consists of twin 10-inch diameter pipes that form a one-third mile long, inverted siphon to connect a local sewer line with the upstream end of the Lake Hills Interceptor (manhole R03-49). The forebay of the siphon is equipped with a slide gate structure to isolate flow to either siphon line. The low point in the siphon is connected to the surface by a cleanout/blowoff valve that is used to drain the siphon lines.

Lake Hills Interceptor

The Lake Hills Interceptor begins at the discharge of the Eastgate Interceptor and Lake Hills Boulevard Siphon and transports all wastewater generated throughout the South Sammamish Basin out of the basin. Within the South Sammamish Basin, the Lake Hills Interceptor consists of 2,100 feet of 48-inch diameter pipe. There are no connections from the local sewer system to the Lake Hills Interceptor within the basin. Downstream of the South Sammamish Basin, the Lake Hills Interceptor continues for another 3.5 miles before discharging to the Eastside Interceptor, which is the major influent sewer to King County's South Plant at Renton. Figure 13 shows the capacity of the Lake Hills Interceptor both in the South Sammamish Basin and downstream to the Eastside Interceptor.

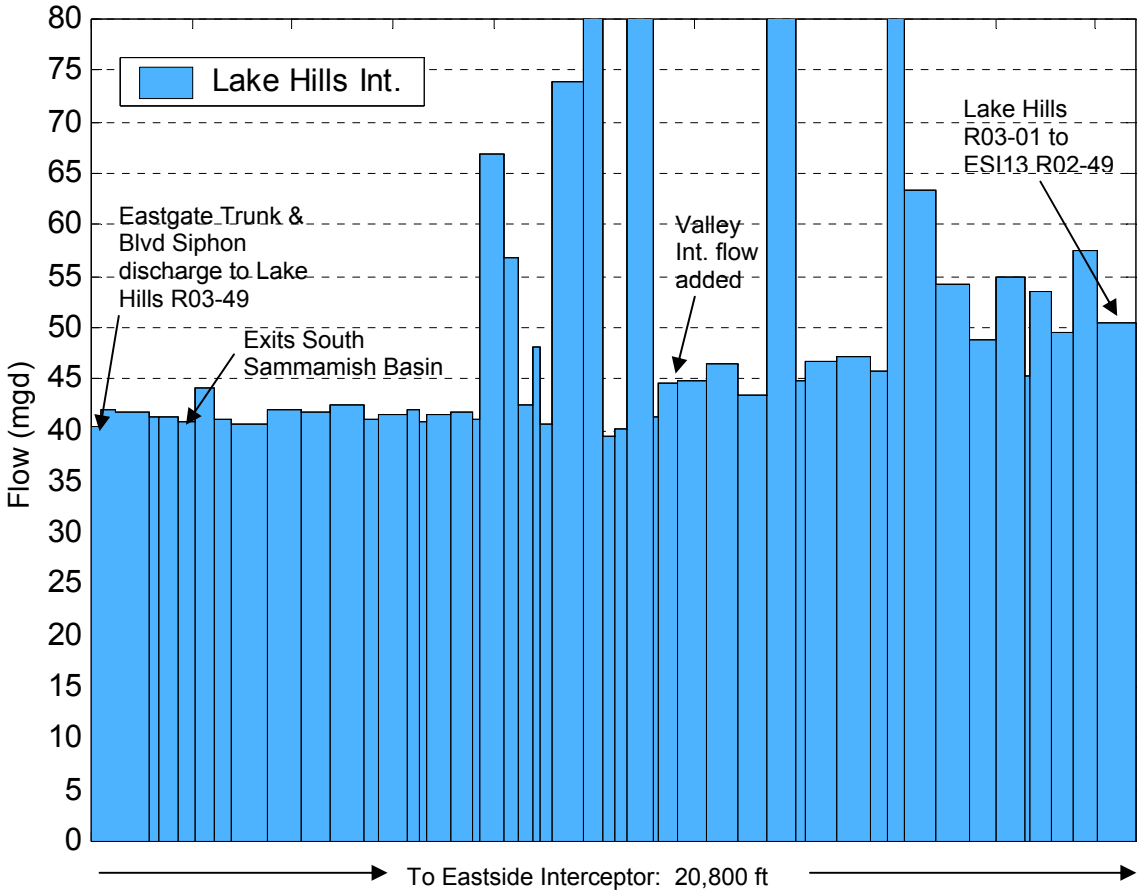

Figure 13. Lake Hills Interceptor full pipe capacity

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APPENDIX A
EASTGATE TRUNK CAPACITY CALCULATION

The alignment of the Eastgate Trunk as two parallel sewers complicates the calculation of the trunk's full pipe capacity. While the two pipes follow the same right-of-way, the manhole locations, pipe slopes and even total pipe length differ between the original and parallel pipe, which was constructed 20 years later. This section describes in detail the steps taken to compute the total full pipe capacity shown in Figure 12.

For this planning study, the CSI project team decided that using the Manning's equation to compute full pipe capacity along each pipe segment (i.e. manhole to manhole) is an appropriate level of detail. The capacities of the original and parallel lines were computed separately (Figures A1 and A2). Figures A1 and A2 are scaled bar charts, where the width of each bar is relative to the length of the pipe section. Careful examination of Figures A1 and A2 shows that the widths of the bars do not lineup precisely - a demonstration that the original and parallel pipe manholes do not lineup side by side.

To best show the combined capacity of the pipeline, the original and parallel capacities were combined into a single graph. The method for summing the two pipes' capacities required some special consideration. Simply overlaying the parallel capacities and the original capacities would create a messy figure with overlapping bars. Understanding that most of the capacity is contained in the parallel sewer, we tried to "lineup" the original and parallel sewers by shifting the individual original sewer capacity bars to match the stations of the parallel sewer capacity bars. Consulting a GIS map of the original and parallel sewers was useful in showing which pipe segments are side-by-side. In locations where the original and parallel pipe reaches are closely aligned, this method is straightforward. For example, the parallel reach from R11-45B to R11-44B is similar in length but offset by approximately 100 feet in station from the original sewer reach, R11-45 to R11-44. The County's GIS sewer coverage shows the two pipes as closely aligned. To illustrate the combined capacity, the capacity of R11-45 to R11-44 was added to that of R11-45B to R11-44B.

When the two sets of manholes are offset by a substantial distance or more than one original sewer ran over the range or a single parallel sewer reach, we used the minimum of the overlapping original sewers. Because the original trunk has a fairly constant capacity of most of its length, and the original sewer makes up only a small portion of the overall capacity, this method is sound.

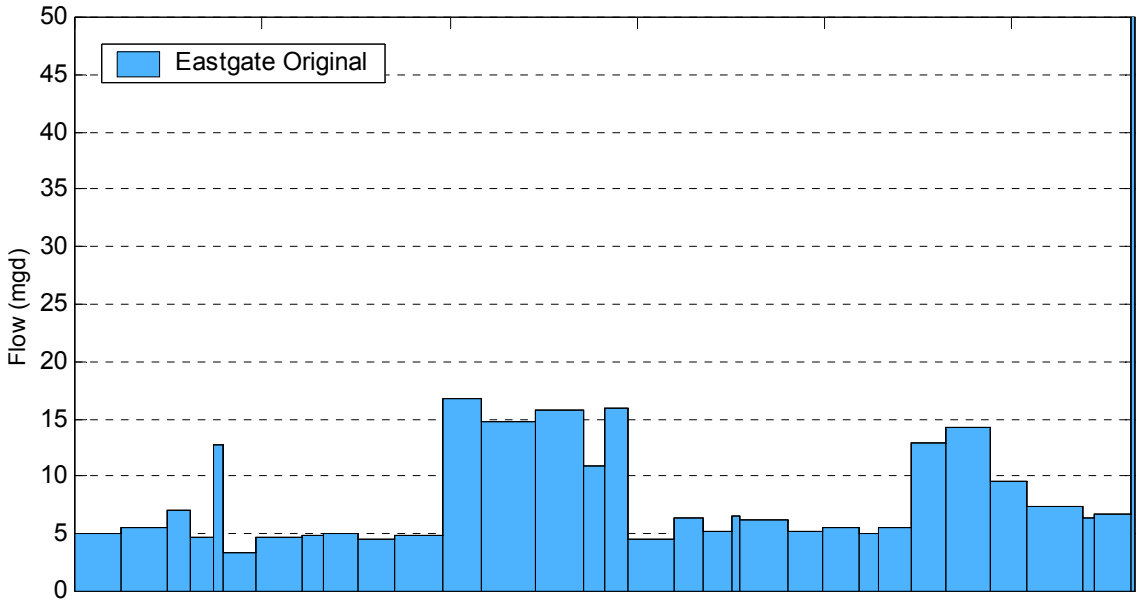

Figure A1. Capacity of the original Eastgate Trunk sewer

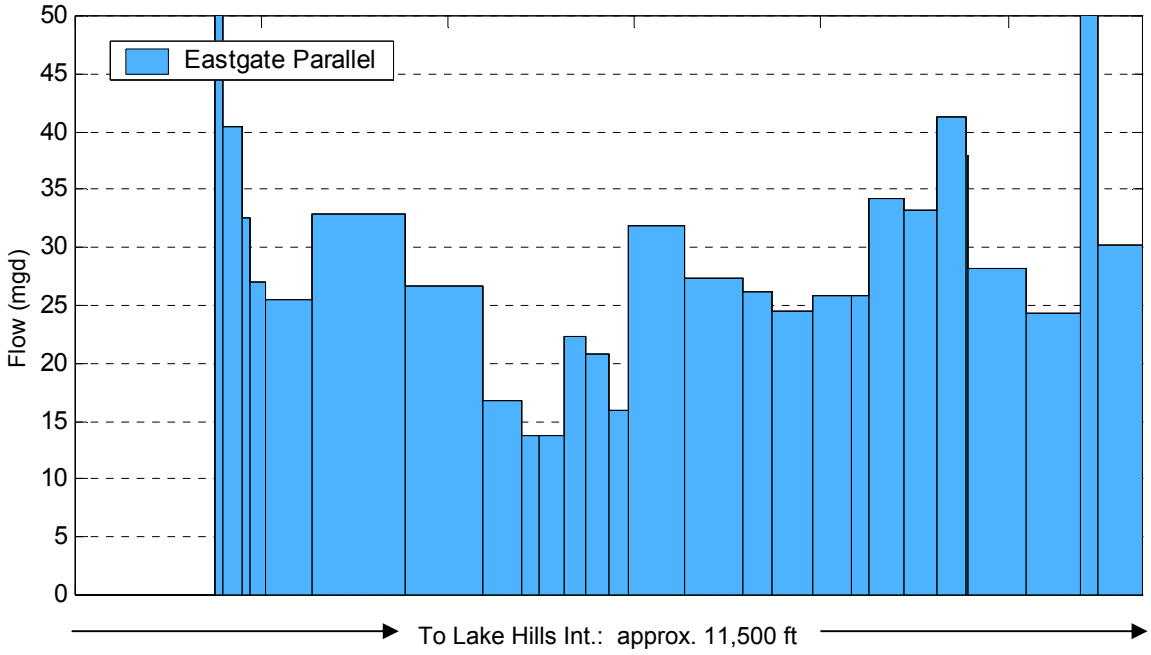

Figure A2. Capacity of the parallel Eastgate Trunk sewer